REMARKS

The specification and claims have been critically reviewed and editorially amended. All of the Examiner's objections and suggestions have been attended to, with thanks for his careful attention and rigorous discussion.

The drawings have been amended as required. Replacement sheets are enclosed, along with the red-marked copies to show the changes that are made. The Examiner is requested to approve the drawings as amended.

There is a fundamental difference between this invention and the inventions shown in the various cited references alone or in combination. It is that the process is neither "wet" nor "dry". The apparatus and process of this invention are not adapted to carry out either a wet or a dry procedure. Its concept is entirely different, both in process and in the product produced by the process.

The "dry" process is probably the one which most commonly used in the field. The auger is thrust into the ground, rotating to loosen and stir the soil while it digs into it. Generally the soil has at least some "available" water, that is, water which is available to hydrate cement. At some time or times, binder in the form of dry cement or lime is added to the soil by the tool. The resulting in-situ piling is comprised of the soil together with and whatever hydrated cement is produced by reaction with

the available water, and all too often there is also some non-hydrated binder for which there was no, or at best insufficient, water.

The quality of the dry method pilings at various depths can vary widely from negligible to optimal. Whatever occurs, it is a rarity for the piling to have the same properties from top to bottom. The dry process has the advantage that all conduitry carries out dry binder that is propelled by air. It does not see any water until after it enters the bore (if there is water there). This equipment will never plug up, but it does not prepare an optimal piling, either.

The "wet" process attempts to overcome the above limitations of the dry process by inserting the binder in a liquid suspension. "Grout" is a word for this (sometimes called "cement milk"). This suspension is supposed to carry the water for hydration. The many disadvantages of this process are evident.

First, the grout will set up as a solid- that is its purpose, but the desired place for solidifying is in a piling, not in the equipment. The grout is mixed in a mixer, and forced through a long hose and out a nozzle. All is well unless things slow down too much, or stop such as for lunch or at nightfall. To provide this, the system must be flushed from all of the grout, presenting a disposal problem, and if not, and it hardens in the system, then the system must be taken apart, the set material

removed, and the system put back together. Often parts such as hoses must be replaced. An expensive nuisance.

In addition to the difficulties with the equipment and the disposition of material removed when the apparatus is cleaned, there is an uncertainty of the quality of the pilings, especially as to the uniformity of strength of the piling along its depth. The wet process would appear to be quite desirable despite its difficulties, because the binder is injected as a liquid stream- a very uniform stream.

The problem lies in this very uniformity of the feed stream. The binder is mixed in a mixer at the surface and fed through long lines to the injection nozzle. What leaves the nozzle is what was mixed some time before at the surface. Now the problem is variability of water in the soil. In most bores there will be significant variation of water cement along the depth. Many bores are nearly dry at the top and wetter below, with considerable variation in between.

Notice that the grout is injected everywhere. There is no adjustment possible.

The instant invention is neither the wet nor the dry method. It eliminates the disadvantages of both of them and achieves better pilings than either one of them can. It is able to convey the binder to the nozzle dry, and can inject precisely the correct amount of binder for each depth and water condition. It

also can inject precisely the amount of water at each depth which when added to the existing available water in the soil and the known amount of binder will hydrate to react with the precise amount of binder. An optimum piling can thereby be made. The running adjustments of water and binder are readily made by valves at the surface, to which emissions at the nozzle quickly respond.

However, to justify the advantages of this invention, it is necessary that the water and the cement arrive as liquid suspension (or mixture) in the bore where it is to mix with the soil. Merely to inject binder some place at some time and water at some place and sometime, and hope to mix them, will not necessarily produce an optimum piling. They can, of course, be subsequently mixed, but the advantages of a similarly uniform mix are at least partially lost.

A particular advantage to attend to "timely" mixing of the water and binder in-situ is the tendency for water to drain after injection, especially in sand and sandy soil. If the binder is added much later than the water, the ratio of burden to cement might change. For this reason among others, it is advantageous for the two streams to merge and mix, or to be merged by mixing within a temporally suitable length of time.

These advantages are attained in this invention by injecting the water and binder through nozzles whose streams intersect to

promptly after exiting the nozzles, or at close enough spaces that within a sufficiently close temporal time, they will promptly be mixed by a vane. Such arrangements are not shown or suggested by the references.

In addition, the claims have been amended to emphasize that the binder is a dry binder.

As amended, the claims recite apparatus and methods which are neither dry nor wet, but some sort of hybrid which makes markedly improved pilings.

All of the claims have been rejected either on Gunther or on Gunther continued with another reference or references. Gunther '700 is applicant's first effort to make a consistent piling. Essentially he injects water and mixes it into the soil. Then he injects dry binder into the wet soil. The places of injection are spaced from one another. The binder is injected radially from the center shaft, and the water from the vanes. There is no closely-related injection of both, either spatially or temporally. The streams themselves are not related.

The claims have been amended to emphasize that the binder is delivered dry, and that the streams are temporally or spatially related so as to mix properly. In the preferred embodiment the streams intersect and continue radially as a combined mixture or suspension. This feature, using dry binder is not shown or suggested by Gunther or any reference or combination of

references with Gunther.

It is submitted that the distinction of use of dry binder, injected in a temporal or spatial relationship as now recited, removes Gunther as a primary reference, and thereby from all of the rejections.

Similarly, Yoshida relates specifically to the wet method. He injects "cement milk", meaning a slurry, and cannot provide the advantages of this invention. He add nothing to the Gunther reference.

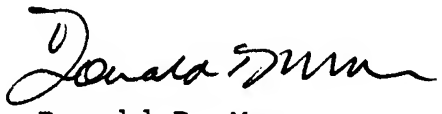
Hockey discloses control systems but not for the precise process. To the extent that controlled systems, are rejected, it is submitted that these limitations are merely in addition to claims otherwise allowable.

As to Blum, it is commented that while he requires enough pressure on grout to get it into the soil, again it is in a liquid system. Nothing is said or suggested about keeping a nozzle clear of liquid so as to forestall curing of grout in the system. Blum is not pertinent to this invention.

It is believed that the above discussion should serve to respond to the rejections of the individual claims. A claim-by-claim discussion would it is submitted be unnecessary. The field of use limitation in itself is believed to be sufficient distinction over the cited art.

Reconsideration of this application, allowance of the claims and passage to allowance are respectfully solicited.

Respectfully submitted,



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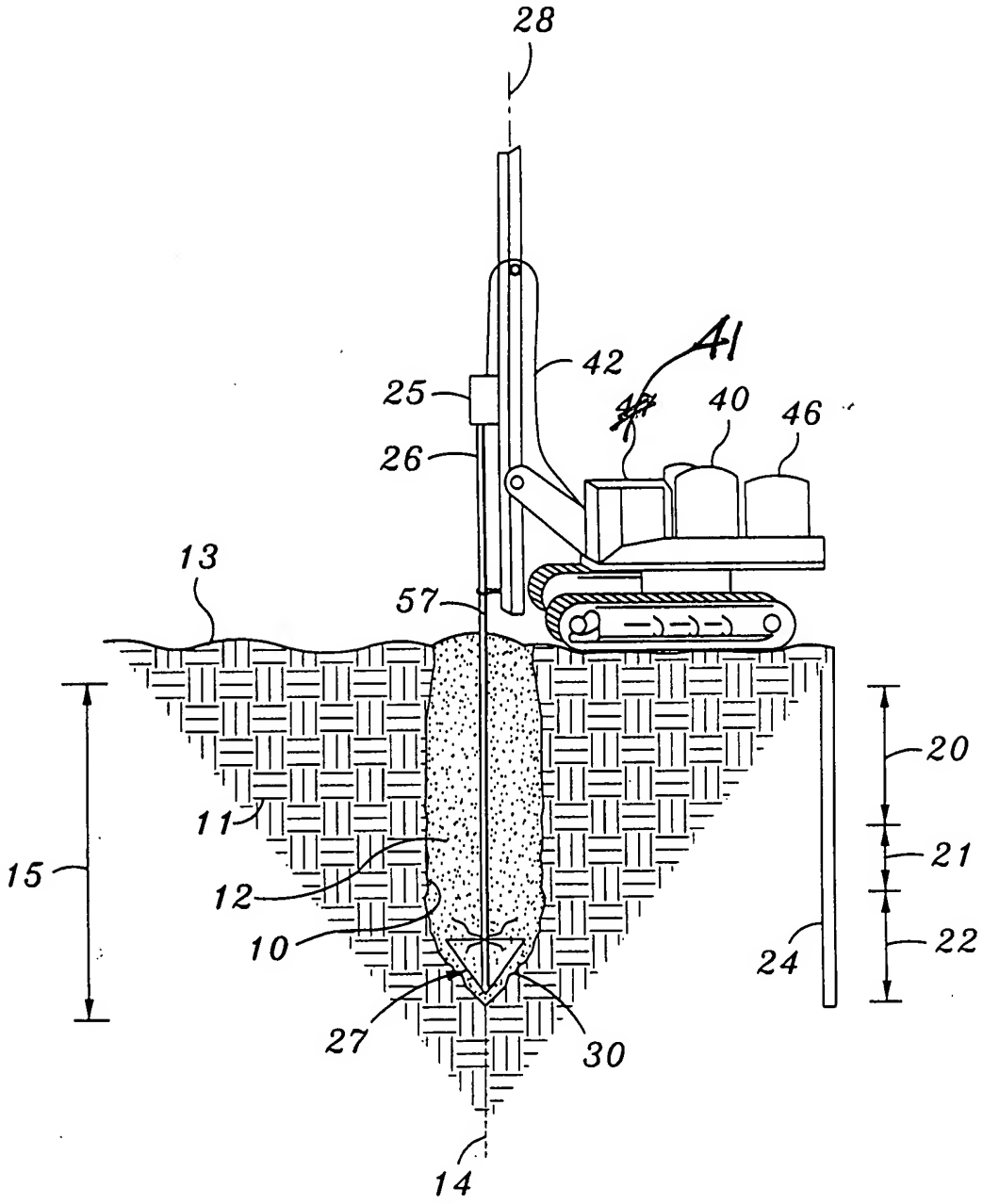

FIG. 1

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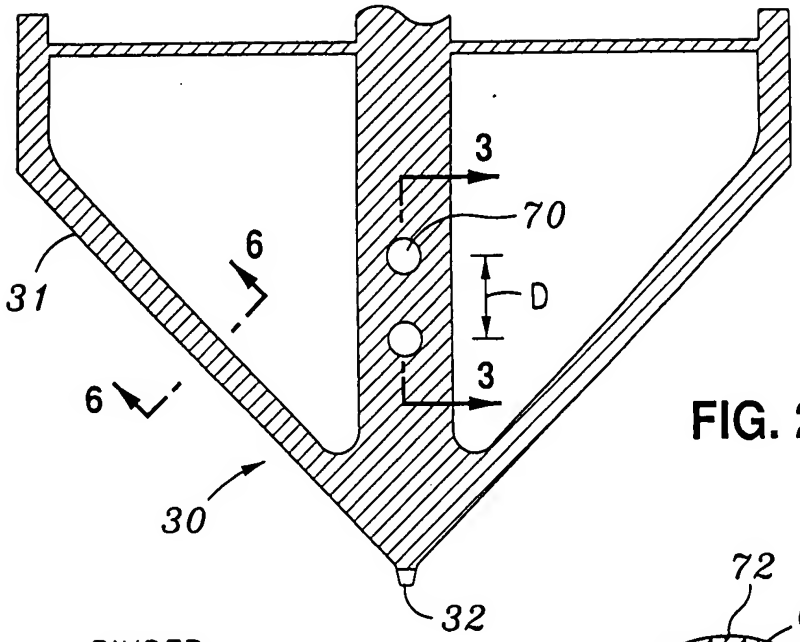

FIG. 2

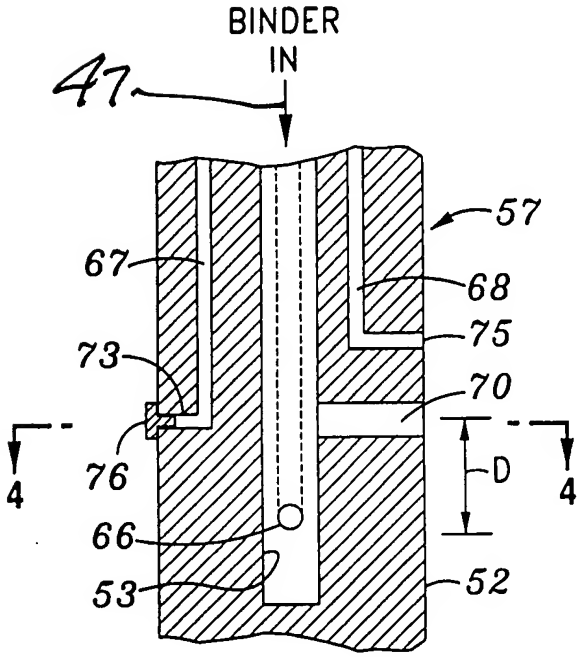

FIG. 3

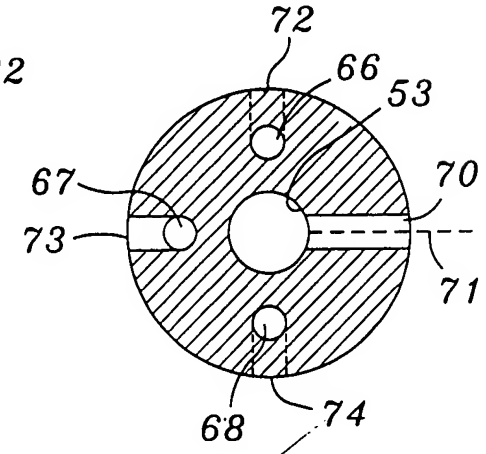

FIG. 4

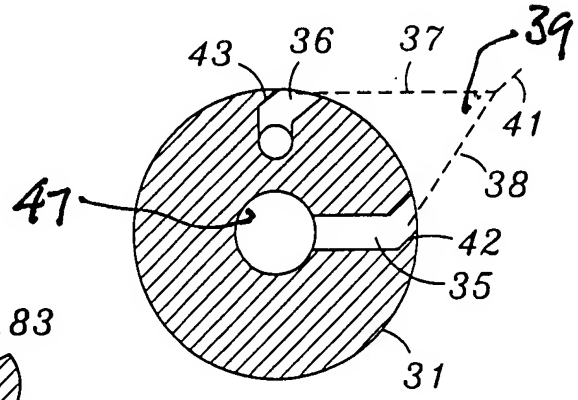

FIG. 5

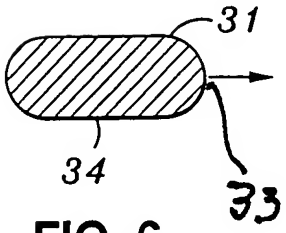

FIG. 6

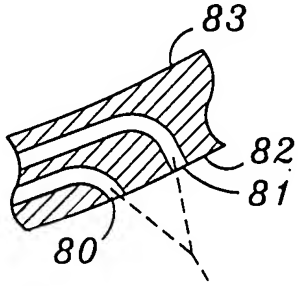

FIG. 7

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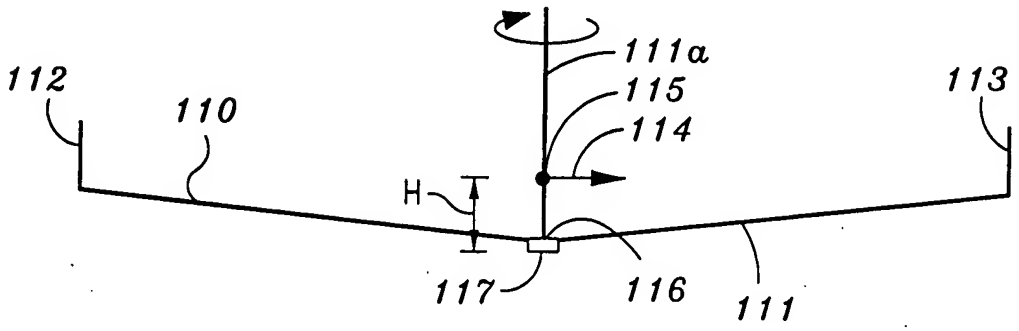

FIG. 9

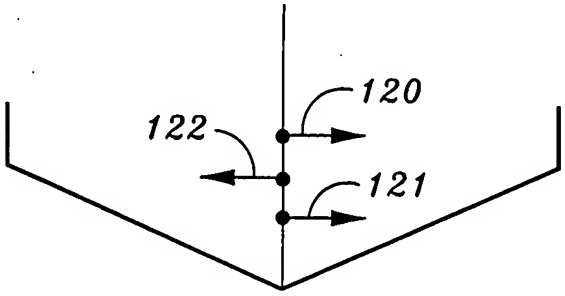

FIG. 10

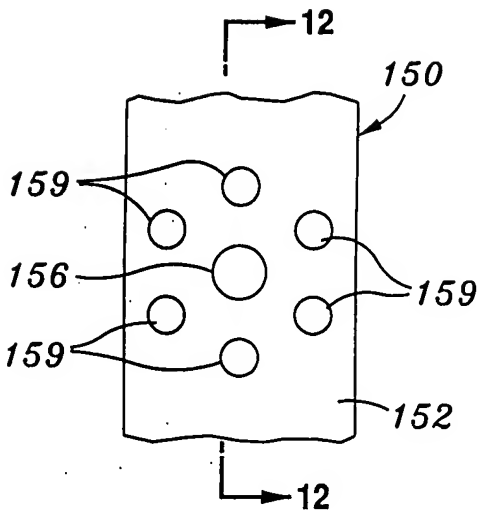

FIG. 11

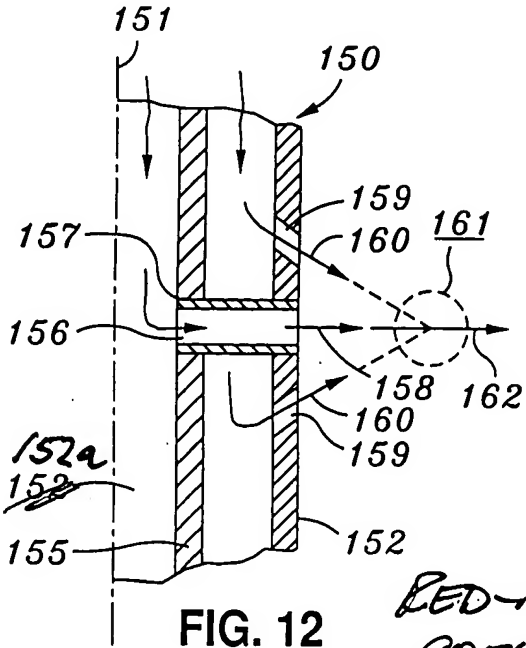

FIG. 12

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